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Subterranean Harpacticoid Copepods of the Amami Group
of the Ryukyu Islands

With 49 Text-figures

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(Communicated by M. UÉNO)

In the summer of 1958, participating in a biological expedition made by the members of the Zoological and the Botanical Institutes of Kyoto University, Dr. Shun-Ichi Uéno and Mr. Yoshinobu Morimoto collected many harpacticoid materials in the subterranean waters of the Amami group of the Ryukyu Islands. They found them in the thirteen wells and the waters in nine caves on four different islands, i.e. Amami-Oshima, Tokunoshima, Okinoérabu and Yoron-jima. The collectors were kind enough to permit the writer to examine all the specimens, among which he was able to recognize 11 species belonging to 9 different genera. Four of these 11 species seem to the writer to be new to science and will be described in the present report.

The writer wishes herewith to express his hearty thanks to Professor Masuzô Uéno of the Otsu Hydrobiological Station, Kyoto University, for his valuable advice and kind supervision during the course of this study. The writer's deep gratitude is also due to Dr. Shun-Ichi Uéno and Mr. Yoshinobu Morimoto, who kindly placed the valuable specimens at his disposal for study.

LIST OF LOCALITIES AND THE SPECIES OBTAINED

Is. Amami-Oshima

No. 1. A driven well (B) at Sumiyoshi-machi, Nazé City; W. T. 19.7°C, pH 6.0; 29-VIII-1958, by S. Uéno and Y. Morimoto.

Nitocrella morimotoi n. sp., 3♂♂, 1♀.

Nitocrella insularis n. sp., 1♂, 2♀♀.

No. 2. A driven well (C) at Sumiyoshi-machi, Nazé City; W. T. 20.9°C, pH 6.0; 29-VIII-1958, by S. Uéno and Y. Morimoto.

Contribution No. 49 from the Spelaeological Society of Japan; Biospelaeological Results of the Ryukyu Expedition 1958 of Kyoto University, No. 8.

- Nitocrella insularis* n. sp., 3♂♂, 1♀.
- No. 3. A driven well (C) at Komata-machi, Nazé City; W. T. 22.5°C, pH. 6.0; 29-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocrella morimotoi* n. sp., 4♂♂, 1♀.
- Nitocrella insularis* n. sp., 1♂, 1♀.
- No. 4. A driven well at Saiwai-machi, Nazé City; W. T. 20.2°C, pH 6.4; 29-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocrella japonica* Miura, 2♀♀.
- No. 5. A driven well in the ground of Nazé Vocational School, Nazé City; W. T. 21.6°C, pH 6.6; 31-VIII-1958, by S. Uéno and Y. Morimoto.
- Elaphoidella aioii* Chappuis, 1♂, 2♀♀.
- No. 6. A driven well (B) at Yakugachi Sumiyô-son, at the southern part of Is. Amami-Oshima; W. T. 20.8°C, pH 6.6; 29-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocrella morimotoi* n. sp., 2♂♂, 2♀♀.
- No. 7. A driven well (C) at Yakugachi, Sumiyô-son; W. T. 21.2°C, pH 6.2; 28-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocrella morimotoi* n. sp., 4♂♂, 3♀♀.
- Elaphoidella aioii* Chappuis, 1♂, 2♀♀.

Is. Tokunoshima

- No. 1. A dug well (B) at Boma; W. T. 24.0°C, pH 6.8; 23-VIII-1958, by Y. Morimoto.
- Nitocra lacustris* (Schmankevitsch), 2♂♂, 7♀♀.
- No. 2. Kenbû-yi Cave at Kenbuku, Isen-son; W. T. 24.0°C, pH 8.4; 24-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocra platypus bakeri* Chappuis, 1♂, 1♀.
- Onychocamptus mohammed* (Blanchard et Richard), 4♂♂, 11♀♀, young 11, copepodid 7.

Is. Okinoêrabu

- No. 1. A dug well (B) at Wadomari, Wadomari-chô; W. T. 22.5°C, pH 7.2; 17-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocra uenoi* n. sp., 2♀♀.
- No. 2. A dug well (A) at Kogomé, China-chô; W. T. 23.0°C, pH 7.4; 1-VIII-1958, by S. Uéno and Y. Morimoto.
- Macrosetella gracilis* Dana, 1♂, 1♀.
- No. 3. A dug well (B) at Kogomé, China-chô; W. T. 23.0°C, pH 8.0; 1-VIII-1958, by S. Uéno and Y. Morimoto.
- Onychocamptus mohammed* (Blanchard et Richard), 2♂♂, 5♀♀, young 9, copepodid 2.
- No. 4. Kunigami-no-kuragô Cave at Kunigami, Wadomari-chô; W. T. 21.9°C, pH 7.4; 16-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocra lacustris* (Schmankevitsch), 1♂, 1♀.
- Onychocamptus mohammed* (Blanchard et Richard), 6♂♂, 5♀♀, young 1. Copepodid 1.
- No. 5. Kibiru-no-kuragô Cave at Kibiru, Wadomari-chô; W. T. 22.2°C, pH 7.4; 16-VIII-1958, by S. Uéno and Y. Morimoto.
- Nitocra lacustris* (Schmankevitsch), 1♀.
- No. 6. Amefuya-yô Cave at Uchijiro, Wadomari-chô; W. T. 24.8°C, pH 7.8; 17-VIII-1958, by S. Uéno and Y. Morimoto.
- Onychocamptus mohammed* (Blanchard et Richard), 4♂♂, 1♀.
- No. 7. Taniyama-no-kuragô Cave at Taniyama, Wadomari-chô; W. T. 21.2°C, pH 8.0; 4-VIII-1958, by S. Uéno and Y. Morimoto.
- Bryocamptus* sp., 2♀♀.

- No. 8. Fuki-gô Cave at Shinjô, China-chô; W. T. 21.5°C, pH 8.0; 7-VIII-1958, by S. Uéno and Y. Morimoto.

Nitocra platypus bakeri Chappuis, 1♂, 1♀.

Parastenocaris oshimaensis n. sp., 2♂♂, 1♀.

- No. 9. Yatu-gô Cave, at Kamishiro, China-chô; 2-VIII-1958, by S. Uéno and Y. Morimoto.

Nitocra lacustris (Schmankevitsch), 1♀.

Elaphoidella bidens (Schmell), 3♀♀, young 1.

Bryocamptus sp., 1♀.

- No. 10. Tamina-no-hô Cave at Tamina, China-chô; W. T. 22.0°C, pH 8.2; 3.7-VIII-1958, by S. Uéno and Y. Morimoto.

Bryocamptus sp., 2♀♀.

Onychocamptus mohammed (Blanchard et Richard), 1♂, 1♀.

Is. Yoron-jima

- No. 1. A dug well (A) at Chabana; W. T. 23.3°C, pH 7.2; 13-VIII-1958, by S. Uéno and Y. Morimoto.

Nitocra uenoi n. sp., 1♀.

Onychocamptus mohammed (Blanchard et Richard), 12♂♂, 10♀♀, young 20, copepodid 12.

- No. 2. A dug well in the ground of Yoron Middle School, at Chabana; W. T. 23.3°C, pH 7.2; 13-VIII-1958, by S. Uéno and Y. Morimoto.

Onychocamptus mohammed (Blanchard et Richard), 1♂.

- No. 3. Ya-gô Cave at Gusuku; W. T. 21.8°C, pH 8.2; 10-VIII-1958, by S. Uéno and Y. Morimoto.

Nitocra lacustris (Schmankevitsch), 1♀.

Onychocamptus mohammed (Blanchard et Richard), 1♂.

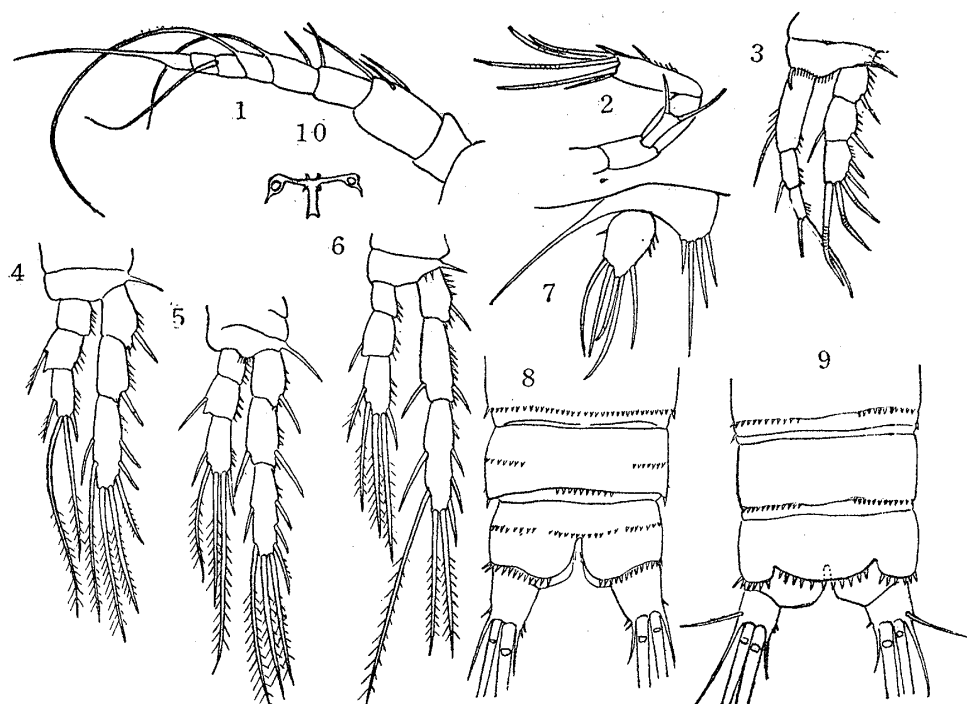
Nitocra uenoi n. sp. (Figs. 1-10)

Female: Length 0.5 mm, including furcal rami. Nauplius eye entirely wanting. Hind margin of each abdominal segment armed on the ventral side with a transverse row of little spines which is, however, interrupted by a space at the middle part on the dorsal side. In the midst of the anal segment, there is a transverse row of spinules on the ventral side.

Furcal rami short and stout, as long as wide, each with a range of spines at the base. Anal operculum concave, with 11 spines. Lateral seta located at distal end of the outside. Middle seta well developed, about 10 times as long as furcal rami; outermost seta long, about 5 times as long as furcal rami; inner seta very short; dorsal seta rather long.

First antenna consisting of 8 segments, sensitive stick attached to the 4th segment. Second antenna 3-segmented; exopodite of A2, one-segmented, short, bearing 2 apical setae. Mandible small; mandibular palp 2-segmented, with 4 setae, one lateral, 3 apical. First maxilla with 3 endites. Second maxilla, also with 3 endites. Maxillipede prehensile.

Exopodite of P1-P4, 3-segmented. The second segment of exp. P1 with an inner seta. Exopodite of P2-P4, of the same appearance. The last segment is longest with 2 inner setae, 2 apical setae and 3 spines on the outer margin. The second segment, with an inner seta. The outer distal corner of the first



Figs. 1-10. *Nitocra uenoi* n. sp., of Wadamari-chô, Is. Okinoêrabu.—1. First antenna.—2. Second antenna.—3. P1 (♀).—4. P2 (♀).—5. P3 (♀).—6. P4 (♀).—7. P5 (♀).—8. Anal segment and furcal rami (♀), ventral view.—9. Anal operculum and furcal rami (♀), dorsal view.—10. Receptaculum seminis.

and second segments rounded, with 2-3 spinules. Endopodite of P1-P4 3-segmented. Endopodite of P1 longer than exopodite. The first segment of enp. P1 is longest but not longer than exopodite, bearing a long inner seta. The first segment of enp. P2-P4 shortest, with spinules on the outer surface. The second segment of enp. P2-P4 angulated on the inner distal corner with an inner seta and spinules on the surface. The last segment of enp. P2 bearing 2 inner setae and 2 apical setae. The last segment of enp. P3-P4, with 3 inner setae and 2 apical setae. Exopodite of P5, with 5 setae. Bendopodite bearing 4 setae and not projecting beyond exopodite. Receptaculum seminis simple.

Male unknown.

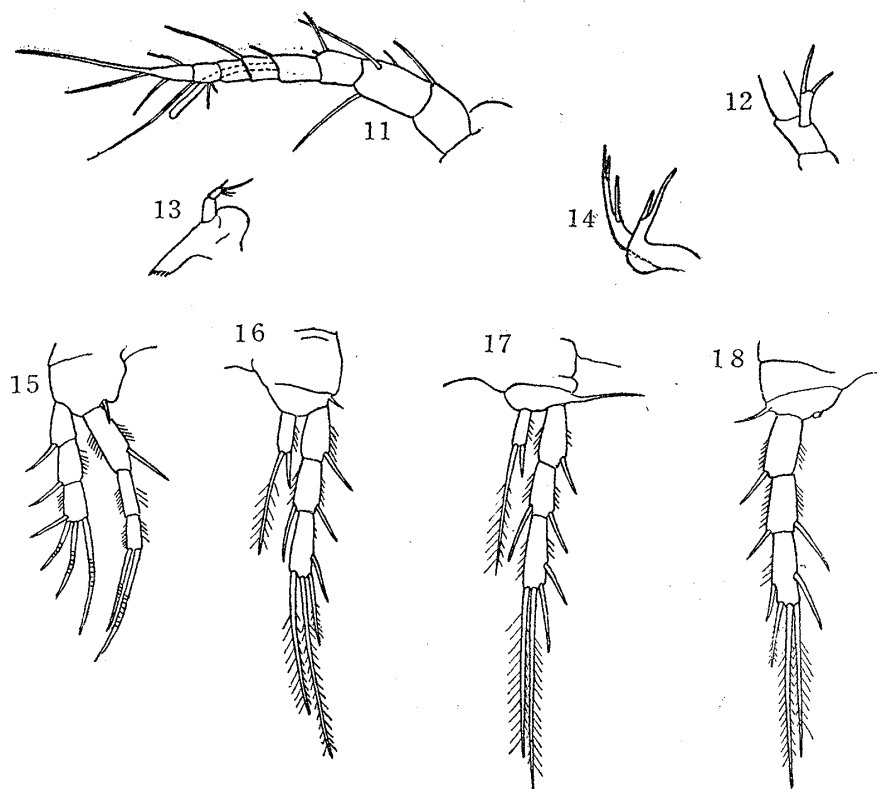
Type-specimens: Holotype, ♀; paratype, 2♀♀ (17-VIII-1958, by S. Uéno and Y. Morimoto).

Type-locality: A dug well (B) at Wadamari, Wadamari-chô, Is. Okinoêrabu, central Ryukyu.

This new species is allied to *Nitocra minor*, but is readily distinguished from the latter by the following characteristics: 1) exopodite of A2 bearing 2 apical setae, 2) 11 little spines on the anal operculum, and 3) bendopodite of P5 bearing 4 setae.

Nitocrella insularis n. sp. (Figs. 11-18)

Female: Length 0.5 mm, including furcal rami. Body worm-like, white in



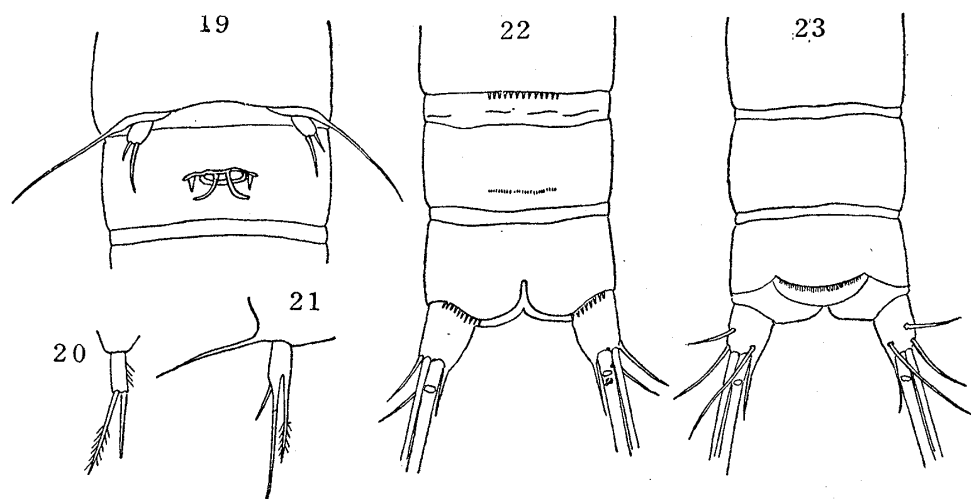
Figs. 11-18. *Nitocrella insularis* n. sp., of Yakugachi, Sumiyô-son, Is. Amami-Oshima.—11. First antenna.—12. Exopodite of second antenna.—13. Mandible.—14. Second maxilla.—15. P1 (♀).—16. P2 (♀).—17. P3 (♀).—18. P4 (♀).

colour. Nauplius eye entirely wanting. Hind margin of each abdominal segment smooth on the dorsal side. A transverse row of spinules present at the middle part of the ventral side. Each furcal remus armed with a row of small spinules at the base. Lateral seta long, located at distal 1/3; an inner mediate seta well developed, about 6 times as long as furcal rami, an outer mediate seta shorter than inner mediate one, about 1/2 long. An innermost seta very short, dorsal seta considerably long.

First antenna consists of 8 segments, sensitive stick attached to the 4th segment, reaching the middle of the last segment. Second antenna 3-segmented. Exopodite of A2 one-segmented, very short, with 2 setae on the apex. Mandible small, mandibular palp 2-segmented with 5 apical setae. First maxilla with 3 endites. Second maxilla also with 3 endites. Maxillipede prehensile.

Exopodite of P1 3-segmented, without inner seta on the 2nd segment. Endopodite of P1 3-segmented, the first longest, with a long seta on the inner margin. The last shortest with 2 long setae on the apex. Exopodite of P2-P3 3-segmented, with an inner seta on the middle segment, and with 3 setae and a spine on the end segment. Endopodite of P2-P3 one-segmented, bearing an inner seta on the middle segment; 3 setae and 2 spines on the end segment, 1 inner, 2 apical and 2 outer. Endopodite of P4 almost degenerated, remained as

a tiny projection with no seta. Exopodite of P5 very small and globular, with 2 setae. Inner part of bendopodite completely degenerated. Receptaculum seminis as shown in Figure 19.



Figs. 19-23. *Nitocrella insularis* n. sp., of Yakugachi, Sumiyô-son, Is. Amami-Oshima.—19. P5 and receptaculum seminis (♀).—20. Endopodite of P3 (♂).—21. P5 (♂).—22. Anal segment and furcal rami (♂), ventral view.—23. Anal operculum and furcal rami (♀), dorsal view.

Male: Length 0.4 mm, including furcal rami, moderately smaller and slenderer than the female. Setae-formula of P1-P4 similar to that in female. The terminal spine of the middle segment of enp. P3 a little longer than in the female. Endopodite of P3 not modified. Exopodite of P5 different in shape from that of the female and bears 3 setae. Bendopodite completely degenerated as in the female.

Type-specimens: Holotype, ♀; allotype, ♂; paratype, 1♂, 1♀ (29-VIII-1958, by S. Uéno and Y. Morimoto).

Type-locality: A driven well (B) at Yakugachi, Sumiyô-son at the southern part of Is. Amami-Oshima, central Ryukyu.

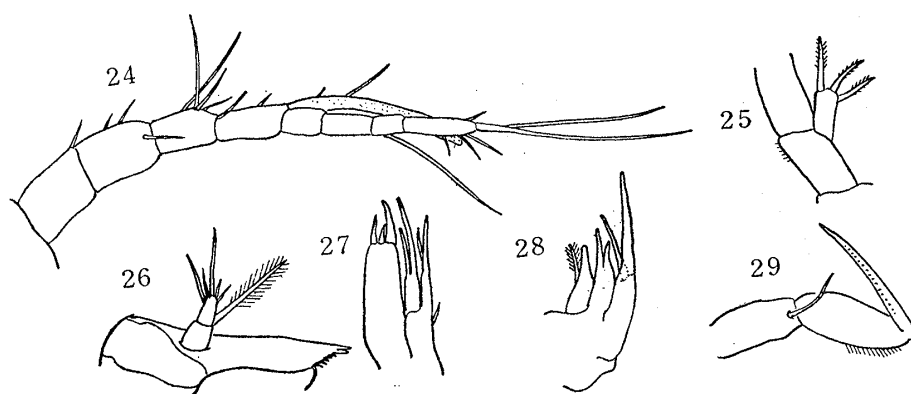
This new species is allied to *Nitocrella dubia* Chappuis. It is, however, evidently distinguishable from the latter by the following points: 1) exopodite of A2 with 2 apical setae, 2) endopodite of P2-P3, one-segmented with a spine and seta, 3) endopodite of P4, remained as a tiny projection, and 4) exopodite of P5 of the female very small and globular with 2 setae and the inner part of bendopodite degenerated.

Nitocrella morimotoi n. sp. (Figs. 24-39)

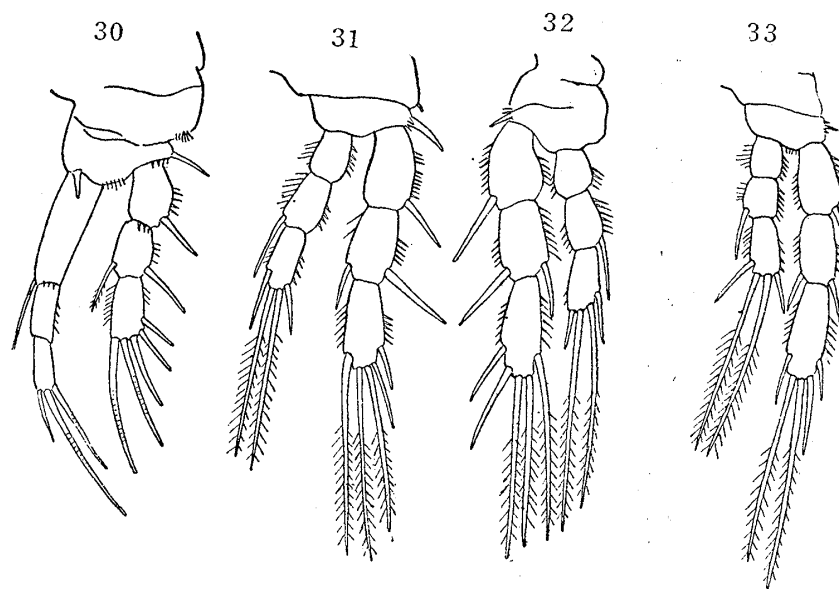
Female: Length 0.58 mm, including furcal rami. Body cylindrical, white in colour. Nauplius eye completely wanting. Hind margin of each abdominal segment armed with a row of small spines both on the ventral and dorsal sides. There is a row of spinules on the connecting part of the abdominal segments.

At the middle part of the anal segment, a row of small spines present dorsally. Anal operculum slightly convex, with about 12 small spines, not extending beyond the anal segment. Furcal rami as long as wide at the base; on the outer surface, there is a long seta and a very short one subapically; inner surface smooth; 3 terminal setae present at the apical part, inner seta very short, the middle well developed, the outer a half as long as the middle. There are several darts surrounding the base of these setae.

First antenna consists of 8 segments. Sensitive stick attached to the 4th segment. Second antenna, 3-segmented. Exopodite of A2 one-segmented, bearing 3 apical setae. Mandibular palp consists of 2 segments, of which the first



Figs. 24-29. *Nitocrella morimotoi* n. sp., of Yakugachi, Sumiyô-son, Is. Amami-Oshima.—24. First antenna.—25. Exopodite of second antenna.—26. Mandible.—27. First maxilla.—28. Second maxilla.—29. Maxillipede.



Figs. 30-33. *Nitocrella morimotoi* n. sp., of Yakugachi, Sumiyô-son, Is. Amami-Oshima.—30. P1 (♀).—31. P2 (♀).—32. P3 (♀).—33. P4 (♀).

segment bears a long seta and the last 5 setae. First maxilla with 3 endites, of which the proximal one bears 2 apical setae, and the middle 2 apical setae; distal endite large, with 3 incurved spines. Second maxilla with 3 endites, each bearing 2 apical setae. One of 2 apical setae is long and stout on the distal endite. Maxillipede prehensile.

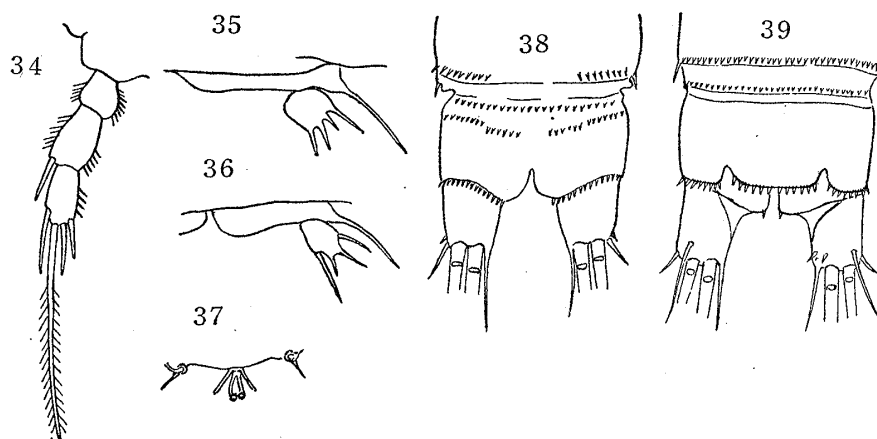
Exopodite of P1 consists of 3 segments, of which the second bears an inner seta and the last with 5 setae, 2 outer, 2 apical and 1 inner. Endopodite of P1 3-segmented, the first segment longest, as long as the proximal 2 segments of exopodite together. The 2nd and the last are nearly equal in length. The last segment terminating in 2 large setae and 1 little seta. Exopodite of P2-P4 composed of 3 segments, of which the 2nd bears an inner seta and the last 5 setae, 2 outer, 2 apical and 1 inner. Endopodite of P2-P4 3-segmented, the 2nd segment with an inner seta and the last bearing 4 setae, 1 inner, 2 apical and 1 outer. Exopodite of P5 simple, with 4 setae. Bendopodite of P5 without seta. Receptaculum seminis simple.

Male: Length 0.57 mm. The first antenna prehensile. Spine- and setae-formula of P1-P4 similar to that in the female. Endopodite of P3-P4 not modified. The shape of P5 somewhat differs from that of the female.

Type-specimens: Holotype, ♀; allotype, ♂; paratype, 1♂, 2♀♀ (28-VIII-1958, by S. Uéno and Y. Morimoto).

Type-locality: A driven well (C) at Yakugachi, Sumiyô-son at the southern part of Amami-Oshima, central Ryukyu.

This new species resembles *Nitocrella subterranea* Chappuis in the features of most parts of exp. P1-P4, but is evidently distinguishable from that by the features of enp. P2-P4, P5 and furca.



Figs. 34-39. *Nitocrella morimotoi* n. sp., of Yakugachi, Sumiyô-son, Is. Amami-Oshima.—34. Endopodite of P3 (♂).—35. P5 (♀).—36. P5 (♂).—37. Receptaculum seminis.—38. Anal segment and furcal rami (♂), ventral view.—39. Anal operculum and furcal rami (♀), dorsal view.

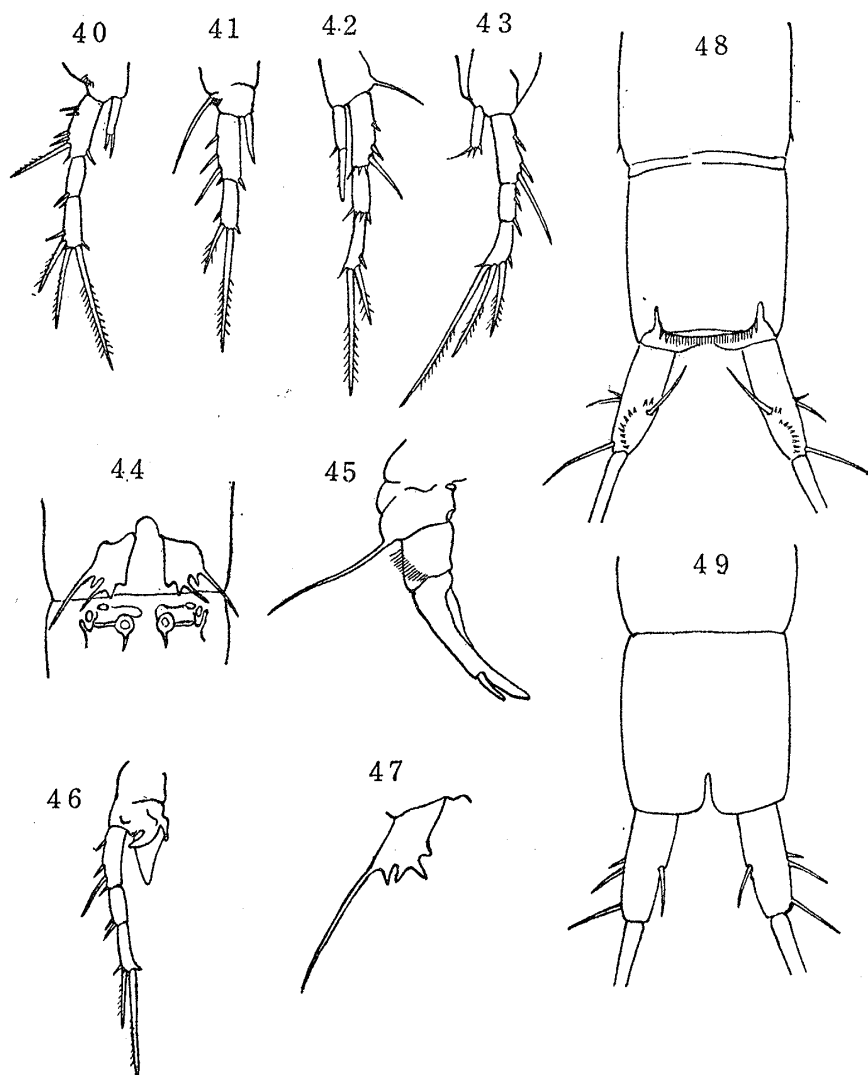
Parastenocaris oshimaensis n. sp. (Figs. 40-49)

Male: Length 0.43 mm, including furcal rami. Body elongated subcylindric-

al; white in colour. Nauplius eye wanting. Hind margins of abdominal segments smooth both on the ventral and the dorsal surfaces. Anal operculum slightly convex, with a row of hairs at middle and 2 little spines on each corner. Furcal rami well developed, long and slender, about twice as long as wide, with 2 setae at the middle part of the outer margin and a seta on the inner margin. The middle furcal seta well developed, long and stout. One little seta inserted on the inner side and a rather long one subapically.

First antenna prehensile, sensitive stick attaching to the 4th segment. Exopodite of A2 one-segmented, with 1 apical seta.

Exopodite of P1 3-segmented, the first segment with 2 groups of small setae



Figs. 40-49. *Parastenocaris oshimaensis* n. sp., of Fuki-gô Cave at Shinjo, China-chô, Is. Okinoêrabu.—40. P2 (♀).—41. P3 (♀).—42. P4 (♀).—43. P2 (♂).—44. P5 and receptaculum seminis (♀).—45. P3 (♂).—46. P4 (♂).—47. P5 (♂).—48. Anal operculum and furcal rami (♂).—49. Anal segment and furcal rami (♀), ventral view.

and a few hairs on the outer side. The 2nd segment bears 2 little hairs on the outer margin. The 3rd segment, with 4 apical setae and hairs on the outer margin. Endopodite of P1 2 segments, of which the first segment bears two groups of small setae and hairs on the outer side, and the 2nd with long apical setae. Exopodite of P2 3-segmented, the terminal segment with 3 apical setae. Endopodite of P2 one-segmented, with 3 little spinules and a hair apically. Coxopodite of P3, with a long seta on the outer distal part. Exopodite of P3 modified, 2-segmented. The first segment bears a range of small spines on the distal part. The "Pauze" on the 2nd segment very slender. Apophysis smaller with an incision on the middle outer margin. Endopodite of P3 wanting. Exopodite of P4 3 segments, of which the first segment is longest, with a long outer spine and the last bears a long outer seta and a long apical one. Endopodite of P4 consists of 2 elements, the one hooked and the other triangular. P5 quadrate and flattened. There is a long and slender seta on the outer distal corner, a little spine on the inner margin and 3 spines on the terminal surface.

Female: Length 0.4 mm, including furcal rami. First antenna consists of 7 segments, sensitive stick attaching to the 4th segments. Anal operculum and furcal rami same as those of the male. Endopodite of P2 one-segmented, with 2 little setae. Endopodite of P3 one-segmented, very simple, like an arrow. Exopodite of P3 2-segmented, the first one with 2 spines on the outer surface, the 2nd with an outer seta and a long apical seta. Endopodite of P4 one-segmented, with a long apical seta. P5 similar to that of the male in general shape.

Type-specimens: Holotype, ♂; allotype, ♀; paratype, 1♂ (7-VIII-1958, by S. Uéno and Y. Morimoto).

Type-locality: Fuki-gô Cave at Shinjo, China-chô, Is. Okinoérabu.

This new species is allied to *Parastenocaris feuerboni* Chappuis found in drifted leaves on the shore of Lake Singkarak in Sumatra. But it differs from *P. feuerboni* in the present of spinules on the dorsal surface of anal operculum and the feature of enp. P3-P4 and P5.

GENERAL CONSIDERATION

There are five main islands of the Amami group, namely Kikai-ga-shima, Amami-Oshima, Tokunoshima, Okinoérabu and Yoron-jima, ranging from the northeast to the southwest between the Tokara and the Okinawa groups of the Ryukyu Islands. So far as the subterranean fauna is concerned, the first-named island has not been investigated up to the present, but all the other four islands have subterranean harpacticoids, though the faunal constituents are not similar to one another. The discrepancy in the harpacticoid faunas between the Island of Amami-Oshima and the other three islands is most striking.

Onychocamptus mohammed (Laphontidae) and *Nitocra*-species (*N. uenoi*, *N. lacustris* and *N. platypus bakeri*) seem to be spread over the Islands of Tokunoshima, Okinoérabu and Yoron-jima, but have never been obtained on the Island of Amami-Oshima despite close investigations made by Dr. Uéno and Mr. Morimoto. *Elaphoidella* and *Nitocrella* are predominant in wells on the Island of

Amami-Oshima. *Elaphoidella* is a genus widely distributed over the southwestern areas of Japan, and *Nitocrella* is found on the Pacific coast of the Island of Shikoku. It may therefore be said that the harpacticoid fauna of Amami-Oshima is much closer to that of southwestern Japan than to those of the other islands of the Amami group.

As was already pointed out by Morimoto (1959, p. 280), the difference in the geological histories between Amami-Oshima and other three islands may be the cause of their faunistic peculiarity. On Amami-Oshima, habitats of subterranean harpacticoids are usually found in the Paleozoic formation, whereas, on the other islands, all the known habitats of such crustaceans are situated in coral limestones that have become raised but recently. Animals of ancient immigration may have become extinct on such recent islands before latest transgression, and have survived at present only on Amami-Oshima, where there is no evidence of land submergence.

It is interesting that *Macrosetella gracilis* Dana, an eurythermal cosmopolitan species, was obtained in a well on the southern coast of the Island of Okinoé-rabu. This purely pelagic harpacticoid may have become adapted to fresh water by some chance and have been able to survive in subterranean water.

REFERENCES

- Chappuis, P. A. 1925 Bihar. Bull. Soc. Sc. Cluj., 157.
——— 1931 Arch. f. Hydrob. Suppl. 8.
——— 1955 Note Biosp., **10**, 183.
——— 1956 Note Biosp., **11**, 61.
——— 1958 Note Biosp., **13**, 71.
Lang, K. 1948 Monographie der Harpacticiden. Hakan Ohlssons Boktryckari, Lund.
Morimoto, Y. 1959 Mem. Coll. Sci. Univ. Kyoto, (B), **26**, 269.